

## X.—A LIST OF SARAWAK MINERALS.—BY J. S. GEIKIE.

---

The following does not pretend to be a full or complete list of Sarawak minerals as the title might lead one to expect, but it is hoped that it may form a basis to which additions may be made from time to time.

A paper entitled "The Distribution of Minerals in Sarawak" was published by the late Mr. A. H. Everett in the Journal of the Straits Branch, Royal Asiatic Society in 1878 and a list of minerals is given by the State Geologist of the F. M. S. in his report on a visit to Sarawak in 1904, and these, with a few scattered references in the various books of travel written about the country, appear to be the only literature on the subject.

Before treating of the distribution of the various minerals, it will be as well to note briefly the main features of the geological history of the country. The most ancient identified rocks are the Jurassic Limestones whose rugged and precipitous outlines form such a prominent feature in the scenery of the country. Overlying this limestone is the series of Shales, Sandstones and Conglomerates, which occur over the greater part of the territory of Sarawak; these in turn are covered by more recent Clay beds and deposits of Alluvial origin.

All the stratified rocks show evidence of considerable earth movement, the bedding in places being much folded, disturbed and faulted, and the rocks themselves are somewhat metamorphosed—Jasperoid Rocks and Quartzites replacing the Shales and Sandstones, and Limestone being sometimes altered to marble.

Numerous intrusions of Granite, Diorite, Porphyry and other Igneous Rocks are found cutting these sedimentary beds in every direction.

Of the minerals which have been observed, it is but natural that the great majority are noted as occurring in the metaliferous districts of Upper Sarawak in which

are found all the deposits of the economic minerals which the country produces, except those of coal and oil.

In this district occur—Antimony, Arsenic, Gold, Cinnabar and Diamonds, whilst coal is found at Sadong, Lingga, Brooketon, etc. and oil at Miri and Brooketon. Of these minerals the Diamonds are found in the Alluvial; the Coal, Oil and Cinnabar in the younger Shale and Sandstone series, whilst the other metals occupy a geological horizon which approximates to the junction of the Limestone and Sandstone series.

Small deposits of Antimony ores occur in different parts of the country above this horizon but have so far proved to be of no economic importance.

#### NATIVE ELEMENTS.

*Diamond.*—Diamonds are found in the Upper Sadong and in the left hand branch of the Sarawak River, where they occur either in the present beds of the streams or in the older alluvial forming the banks.

The stones found are mostly small and full of flaws. Search for these is carried on in a very desultory manner by Malay fossickers who confine their attention chiefly to the beds of the streams, which can only be worked during dry weather.

There is no direct evidence of the origin of these stones but it is possible that they may be derived from the disintegration of the beds of conglomerate through which these rivers flow in places as at Pangkalan Ampat.

In support of this it may be noted that Diamonds are also found just over the Sarawak border in the Skiyam River whose waters also cut through similar conglomerate beds.

*Arsenic.*—Occurs in Upper Sarawak and more particularly at Bidi, where large reniform masses are frequently found in the limestone fissures along with Gold and Antimony Ores.

Nowhere does it occur in quantity sufficient to make it of much commercial importance; in fact its presence

in so many of the Gold and Antimony ores is most objectionable from the metallurgist's point of view.

*Antimony.*—Specimens of metallic Antimony have been found in most of the metaliferous deposits of Upper Sarawak, but only in the Limestone hills near Busau has it occurred in any quantity. Here it is found in masses, some of considerable size, lying in fissures in the limestone and also in the Alluvium round the foot of the hills. At no time has its production formed more than a mere fraction of the out-put of Sarawak Antimony.

*Gold.*—Gold is and has been for some years the chief metal export of the country, practically the whole amount having been derived from the Bau and Bidi gold mines in Upper Sarawak; the native alluvial washings produce only a small and very uncertain quantity.

The metal has a wide distribution, having been found in the Rejang at Sariki, in the Batang Lupar at Marup, in the Sadong at Melikin and elsewhere, in the Samarahan at Sirin, and practically all over Sarawak Proper. Most of these deposits are however only low grade alluvials of no extent.

At Bau and Bidi gold occurs in a series of Marls and Shales pierced by numerous dykes, the rocks in the auriferous zone being brecciated, much altered, and silicified, and retaining but little trace of their original form. These masses of altered rock are found to extend along a series of fault lines and there is little doubt that the origin of the gold is closely connected with the presence of the dykes and these faults.

The gold which is alloyed with some 20 per cent of silver is in an extremely fine state of division, being rarely visible; what coarse gold there is occurs in thin leaves and plates. Along with the gold are found Arsenic, Antimony, Stibnite pyrites, Realgar etc.

*Silver.*—Only occurs alloyed with gold.

*Mercury.*—Small quantities of Mercury were observed from time to time while working the Tegora Cinnabar deposit.

#### SULPHIDES, ETC.

*Realgar.*—Of frequent occurrence in the gold bearing shales of Bau and Bidi, generally as small crystals



disseminated through the ores, but also found in an earthy form, and occasionally in large translucent crystals.

Other localities which have been noted are at Gading and M'rau, Ulu Skiyam in Dyke rocks, at Puak in Limestone, also Ulu Sadong, Sariki, Baram etc.

*Orpiment*.—Found associated with Realgar.

*Stibnite*.—The most common ore of Antimony.

For many years Antimony formed the chief mineral export of the country but with the fall in value of the metal and the gradual exhaustion of the deposits the production is now merely nominal. This mineral is widely distributed, having been found in Upper Sarawak, Lundu, Samarahan, Sadong, the Batang Lupar, Sariki, Bintulu etc.; however only the Upper Sarawak deposits have proved to be of any value.

The common forms in which Stibnite is found are large granular lumps, masses of acicular crystals or finely disseminated in veinstone.

A rare form has the appearance of black wool.

*Galena*.—Of occasional occurrence with the Antimony and Gold Ores of Upper Sarawak and has also been found in a small vein in Santubong Mountain.

*Zinc Blende*.—The black variety is found in one or two places in Upper Sarawak but is of no economic value.

*Cinnabar*.—Deposits of Cinnabar are found in Upper Sarawak at Tegora and Gumbang, the former was exhausted some years ago, but at the latter the ore was found to be too poor to work.

At Tegora the Cinnabar occurred as an impregnation in a series of much shattered shales and sandstones which form a hill at the foot of the Bungo Range of mountains. During mining operations the whole top of the hill was removed and a large chamber excavated in the hill itself.

Traces of Cinnabar have also been found in the Samarahan and Sadong districts.

*Chalcopyrite*.—Occasionally found in a few of the Upper Sarawak ores.

*Iron Pyrites*.—A very common mineral which however is only found in small crystals, veinlets and concretions, no deposit of any extent being known.

*Arsenical Pyrites*.—Not so common as Iron Pyrites, but is present in most of the Ore deposits of Upper Sarawak.

*Kermesite*.—Antimony Oxy-sulphide found in many of the Antimony deposits as an alteration product of Stibnite.

*Jamesonite*.—Occasionally found in the Upper Sarawak Ores, generally carrying high gold and silver values.

*Proustite*.—Ruby silver ore. The late Mr. A. H. Everett mentions this mineral as having been found in Upper Sarawak.

#### CHLORIDES, ETC.

*Rock Salt*.—Brine springs are reported in the Ulu Baram and elsewhere which points to the possible presence of deposits of salt.

*Calomel*.—Observed in the Cinnabar deposit at Tegora.

*Sarawakite*.—Probably a Chloride of Antimony. A. Frenzel in his Mineralogy of the Eastern Archipelago records its occurrence.

#### OXIDES.

*Quartz*.—Extremely common both in its massive and crystalline forms. No large crystals have been found.

*Chalcedony*.—Occurs lining fissures and cavities in both igneous and sedimentary rocks.

*Chert*.—Very common in Upper Sarawak where it occurs massive and also in bands and layers of nodules in the limestone.

*Hyalite*.—One of the opal forms of Silica found in several localities in Upper Sarawak, lining the sides of cavities and fissures in shales.

Some specimens have the appearance of drops of colourless resin, but the majority are yellow and brown owing to the presence of Iron oxide in the mineral.

*Sapphire*.—Sapphires are found in the Upper Baram, but the stones are small and of no value.

*Corundum*.—Occasional small pebbles of this mineral are washed up during the search for Diamonds.

*Hæmatite*.—A few small pockets of this ore have been found in Limestone in Upper Sarawak.

*Magnetite*.—Occasionally found but never in any quantity.

*Laterite*.—Under the term Laterite may be classed the majority of the Iron ore deposits of the country; these are as a rule small and the percentage of metal very irregular.

Native smelters produce a very high class Iron from some of these ores.

*Limonite*.—Nodules of Limonite are found in certain beds in the coal measures.

*Wad*.—An Impure Manganese ore of very general distribution found in amorphous earthy masses and as incrustations and stains; many of the black and brown clays of the country owe their colours to this mineral.

*Psilomelane*.—Another common Manganese ore. Near Lundu it is found in irregular bands traversing a series of altered shales. This is the only place in the country where any attempt has been made to exploit Manganese, the deposit however proved to be only a surface enrichment.

*Bauxite*.—Occurs at Puak as small concretionary nodules in clays resulting from the decomposition of impure limestones.

*Senarmontite*.

*Valentinite*.

*Cervantite*.

These three oxides of Antimony have all been found in Upper Sarawak. Senarmontite alone occurs in any quantity and is one of the ores exported. The clays round the Limestone hills near Busau afford the main supply of this oxide; from these it is washed up in the form of grains and amorphous lumps.

#### CARBONATES.

*Calcite, Limestone, Marble*.—Carbonate of Lime in a variety of forms is well represented in the country. Limestone seamed and veined with Calcite and sometimes altered to marble, outcrops all over Upper Sara-



wak in the south, and from here it may be traced in a more or less interrupted band extending to the head waters of the Limbang River in the North.

*Siderite*.—Frequently found in small grains in the cave alluvials of Upper Sarawak.

*Malachite* and *Azurite*.—These Carbonates of Copper were included by A. H. Everett in his list of Sarawak Minerals, as is also :—

*Cerussite*.—The Carbonate of Lead.

#### SILICATES.

<i>Felspar.</i>	<i>Schorl.</i>
<i>Hypersthene.</i>	<i>Muscovite.</i>
<i>Augite.</i>	<i>Biotite.</i>
<i>Hornblende.</i>	<i>Olivine.</i>
<i>Epidote.</i>	

The above Silicates have only been detected as constituent or accessory minerals in the various igneous and altered sedimentary rocks, and call for no further comment.

*Zircon*.—Common in all the alluvials, particularly so in some of the limestone cave deposits, where it is generally associated with Garnets and Gold. It occurs in perfect crystals of microscopic size.

*Garnet*.—Garnets have been observed in some of the dykes traversing limestone ; they are very small, as are also those found in the Alluvial deposits.

*Talc*.—A common mineral especially in the brecciated shales and marls of Upper Sarawak ; it is always of the massive foliated type, never crystalline.

#### PHOSPHATES.

*Wavellite*.—Some large masses of a beautiful blue colour were found lining a cavity in gold ore at Bau.

In its white form it is fairly common.

*Apatite*.—An accessory mineral of some dyke rocks and altered marls.

#### ARSENATES.

*Scorodite*.—An Arsenate of Iron found in amorphous lumps in clay at Puak, Upper Sarawak.

#### ANTIMONATES.

*Bindheimite*.—Antimonate of lead.

Occurs as an incrustation, or amorphous. A result of the decomposition of other Antimony ores.

## SULPHATES.

*Gypsum*.—Occurs at Ayer Panas near Sennah as a deposit from the hot spring.

## HYDROCARBON COMPOUNDS.

*Coal*.—Coal is found in a number of localities the most important being Sadong, Brooketon and Lingga. At Sadong a single seam has been worked for many years, at Brooketon there are two nearly vertical seams 18 to 20 feet thick, whilst Lingga has not yet been exploited but there is reported to be a good seam there, the outcrop of which can be traced for a considerable distance.

Besides these, numerous occurrences are reported all along the coast from Sadong to the North; none of these however have as yet been prospected.

*Oil*.—Mineral oil occurs in the Coal measures and follows the latter mineral in its geographical distribution.

Finds are reported at Sadong, Brooketon and Miri but none of these places has as yet produced oil in any quantity; boring operations are however being carried on at Miri which have so far met with encouraging results.

*Mineral Resin*.—Both the Sadong and Brooketon coals occasionally contain small pieces of Resin.

---